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APPLICATION OF HYDROLOGY IN WATER RESOURCES DEVELOPMENT IN AFGHANISTAN

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APPLICATION OF HYDROLOGY IN WATER RESOURCES DEVELOPMENT IN AFGHANISTAN

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TRADITIONAL PRACTICES IN WATER MEASUREMENT AND DISTRIBUTION:

1. Afghanistan located in the central part of the Asian continent is of mountainous physical nature. The existence of mountain ranges in the northern and central parts and flat areas and desert zones in the south creates a variable nature as far as topography, climate, water and soil resources and other natural characteristics are concerned. The extremes, that are, freezing and snow in majority of the northern region and hot and dry nature of the south compells us to not think of practicing simple methods of hydrological investigations, but various and elaborate methods and procedures have to be applied.

2. Application of modern techniques of hydrology have taken place very recently in Afghanistan, and old regional practices were and to a certain extent are customary, These traditional practices were not carried on in order that the results be used for design of irrigation system, flood control or as basic data for water development planning, but the sole intention for use of these practices was to facilitate in the distribution of water among water users for irrigation. Estimate of quantity of water was made in a rough manner considering the width and depth of water, but there was no means for determining the velocity component of discharge. Also the quantity of water required for operating a water wheel of a flour mill (in general the wheels are made of wood with outer diameter of vanes about one meter, with vertical shaft) called a "mill water" served as an approximate unit of discharge in distribution of water. This amount of discharge is about 1.5 to 2 cubic feet per second. The discharge of canals is approximated in terms of so many 'mill waters' by the parties concerned and is distributed among them. This practice is still very common among the farmers. Construction of masonary or wood structures with a number of openings in the form of rectangular wiers for distribution purposes is also practiced, which is the most effective and satisfactory means of water distribution in many localities among farmers.

3. Only relative quantity of discharge from the water marks on banks of channels

left after floods were observed and compared to historical flood quantities. For the rivers where no data is available, this visual and comparative study is still practiced and use is made of it for the development investigations.

ORGANIZATIONAL ASPECTS OF HYDROLOGICAL SERVICES:

4. In Afghanistan where agriculture is the back bone of the country's economy, for the expansion of agricultural activities and raising its standard, it is a must that effective use of the water resources be considered. In order to meet the requirement for irrigation, power production and domestic needs, it is understood that coordinated efforts with regard to the use of water is needed. Investigations, collection of basic data and appraisal of water resources of the country which are essential to the scientific planning of irrigation, water supply and hydro-electric projects have to be performed in a more effective manner.

5. In Afghanistan the responsibility for water resources investigation is divided among several agencies with none of them exercising the functions of coordination and the establishment of uniform standards. As a result there is a considerable amount of inefficiency and duplication of efforts in the collection and use of basic hydrological data for the water resources development programs.

6. Water as the main resource of the country, it is stressed upon that the responsibility for its management and its operation should not be divided according to use that is irrigation, energy development, water supply and control. Since water resources investigation, management and development is a continuous concern, it needs long range programs based on stable policy and organization.

7. In the field of water development investigation in Afghanistan, having considered the important factors such as, the varying, nature and scope of water requirement, urgency and quantity of water needed for development plans, establishment of water rights and legislation, lack of sufficient number of technical development, lack of conformity and irregular standards of work, lack of complete coordination among various agencies and their effectiveness and result high expenditures, important step is taken towards the centralization of the various agencies into one organization. This organization could best provide coordination, regular direction, stability to water resources investigation programs and planning for development.

8. The functions of this central organization are:

(a) General study of surface and ground water in Afghanistan.

(b) Collection of measurements of surface water by use of modern technical means and presentation of data to national and international interested groups.

(c) Coordination of water construction works

(d) Study of flood control

(e) Study of possibilities of formulation of the Afghan water legislation and water policy.

(f) Completion of the hydrometric network of the country.

(g) Detailed study and exploration of ground water in promising areas.

(h) Presentation of subsurface water data collected to agencies concerned.

(i) Compilation of data for design of water development projects.

(j) Drilling exploration and development wells for ground water.

(k) Preparation of standard specifications for completion of water wells.

(l) Acting as consultant in the utilization of surface and ground water to interested parties.

(m) Study of solid and load transport of water bodies.

(n) Analysis of water

(o) Collection of hydro-meteorological data and analysis.

IRRIGATION - POWER STUDY ON OPERATION OF ARGHANDAB DAM RESERVOIR AND ITS AFFECT ON IRRIGATION SUPPLIES:

9. The Arghandab dam located in Kandahar province completed in 1952 on Arghandab river with its primary function to supplement the low water flow of Arghandab river for irrigation use. Generation of hydro-electic power is also provided to serve the need of the city of Kandahar. The dam as an earthfill embankment, is 50 meters high, crest width of 540 meters, with a storage capacity of 388,000 acre feet. Irrigation water is led through a tunnel in the right abutment controlled by two valves and gates. Outlet for power is also located at tail end of the tunnel.

10. Since no prior stream flow records were available a design flood hydrograph was developed by analitical methods, considering flood records from snow fed streams in other parts of the world having comparable watersheds. From these investigations the spillway capacity was determined to handle a maximum discharge of 225,000 cubic feet per second.

11. A study is made of the maximum combined output for irrigation and power development in the operation of the Arghandab reservoir. The fourteen years data from 1947 to 1961 is used and efficient operation computed month by month and year by year for the entire period. Average monthly inflow, required monthly diversion and average usable diversion as percentage of totals for average year is shown in table (I).

12. The study is based on full irrigation of 105,000 acres (41% vineyard, 26% wheat, 20% orchards, 13% cotton with cover crops, summer and winter legumes and vegetables), using an average irrigation efficiency of 55%, a delivery efficiency of 75%, a return flow usage of 5%. Generation of 9,600 kilowatts for six months and 2,500 to 7,500 kilowatts for the remaining months of the year and in so far as possible a full reservoir at begining of June and a carry over of 120,000 acre feet is also anticipated.

13. Particular attention was given to the fact that the months of June, July and August are the hottest months of the year, accounting for over 40 percent of the total annual evaporation and have no effective rainfall (out of 7.3 inches 5.4 inches of rainfall is effective). Consumptive use is highest. About 60 percent of the inflow to the Arghandab reservoir comes in during three months of March, April and May and the reservoir holds only about 30 percent of the annual runoff. Mean monthly rainfall, mean monthly temperature, wind velocity and measured evaporation from water surface for Kandahar area is shown in Fig. I.

14. In table (2) the usable reservoir release, evaporation losses, the uncontrolled spill and the reservoir release in terms of overall irrigation requirements, for average of fourteen years, average of eleven high water year and average of three low years is shown. This summary indicates that the eleven high years produce 126 percent, the average of all fourteen years produce 114 percent and

the average of three low years produce 70 percent of the overall requirement for irrigation (730,000 acre feet). The uncontrolled spill may be diverted and used for wheat or other crops which are needing water for maturity at that period.

15. The application of this studied and recommended operation required a change in the irrigation practices of the farmers and strict control of water in the irrigation zones. To change the irrigation practices already customary among the farmers takes time and effort. Due to lack of proper diversion and intake structures at the canals 15 to 20 percent of water released for irrigation, during the months of low flow could not be lifted and is wasted. Excessive water was demanded to raise the water level in the river channel to the limit possible for diversion into the canals. Therefore the operation of the storage reservoir exactly in compliance with the studied case was not possible at that stage, but year by year improvements are visualized and the difference between the practiced and recommended operations becomes less.

SOME METHODS AND APPLICATION OF HYDROLOGY:

16. Application of modern techniques in hydrological investigation in Afghanistan has taken place about one and half decades back. At that time, planning of vast water development program in the south emphasized upon the urgency and need of the basic hydrological data of the rivers flowing in the southern part of Afghanistan.

17. In accordance with technical standards design and construction of hydrological investigation station, collection and analysis of hydrological data is being performed. With the hydrological stations in existance (see fig.II) a complete appraisal of water resources of Afghanistan is not possible at present, but the intensification of hydrological network is to be carried on in order to give us a more detail and clear picture of the country's water resources. Stations including automatic water stage recorders, cableways, evaporation pans, rain gauges are installed on major rivers and additional similar installations will be completed on the remaining water courses.

18. Masonary orcorrugated metal pipe shelters for automatic water stage recorders are erected, but due to difficulties in obtaining the large diameter corrugated metal pipe in the country the use of rock masonary structure is best adaptable. Transportation problems and lack of roads to many of the gaging sites also favour the masonary construction of shelters.(see Fig.III)

19. Erection of staff gages outside the shelter is practices on all of the stations where with tape measurement of water level inside shelter, checks the automatic stage recordor readings. Readings of outside staff gage observed regularly by gage readers during the flood period is substituted for the lost records in cases when the inlet of the automatic recorder-shelter is plugged by silt deposits. Similarly during the freezing season when water inside the recorder shelter freezes and the operation of the automatic recorder stops, then by breaking the ice around the outside staff gage direct reading of the water stage is obtained from the staff gage. The existence of excessive draw down, and plugging of inlet of the shelter is normally determined from the existance of a difference between the readings of outside and inside staff gages.

20. Due to safety reasons, accuracy of measurement and complications due to boat drift and application of correction, preference is given to the discharge measurement from cableways than from boats. Direct discharge measurements is made by wading in low water period, but during the high water period cableways are used.

21. Single track cableways are erected close to recorder structures on the major rivers, and construction of double track cableways are underway on some of the central rivers. It is anticipated that the carriage (cable car) on a double track cableway will be more stable against the lateral movement due to wind forces. Of course after a period of experience and comparing the two types of cableways construction as to their operation, effectiveness accuracy of measurement and cost, one of the two types will be selected and applied on the remaining stations to be completed in future. It should be mentioned here that the unbalanced cross river movement of the four wheels of the carriage on the wire rope tracks caused by the existance of a difference in sag in the two tracks, will create difficulties, unless exactly equal sag is applied on the two tracks.

22. Installation of automatic longtime operated water stage recorders is necessary on many of the stations. A number of 90 days automatically operated recorders are also installed, where the regular 30 days duration recorders are used on majority of the stations. Due to remoteness from towns and villages and difficulties with regard to accessibility of the station and snow covered passages during 4 or more months of the year application of block-and-tackle arrangement of pulleys to allow long-time operation of recorders is also considered, where the clock weight of the recorder is manifolded, and time between recorder inspections has increased.

TABLE 1

ARGHANDAB RESERVOIR WATER RELATION FOR AVERAGE CONDITION AT FULL DEVELOPMENT

Monthly percentage of Average year

Months	Average inflow %	Required Diversion %	Average usable Diversion %
October	1.96	3.42	3.25
November	3.25	3.42	2.70
December	4.35	3.42	2.70
January	5.20	3.42	2.70
February	7.62	3.42	3.80
March	20.74	3.42	10.80
April	27.70	14.96	14.85
May	16.82	19.64	15.35
June	5.40	11.80	10.80
July	4.06	16.45	13.00
August	1.70	13.75	13.00
September	1.20	2.88	7.05
Total	100.00	100.00	100.00

TABLE 2

SUMMARY OF IRRIGATION - POWER STUDY ON OPERATION OF ARGHANDAB RESERVOIR

	Inflow Acre feet	Usable Reservoir release Acre feet	Evaporation losses Acre feet	Uncontrolled spill Acre feet	Release in % of overall requirement
14 years average	1039700	835000	37000	165000	114
Average of 11 high water year	1226000	920000	40000	250000	126
Average of 3 low water year	507062	512450	30000	none	70

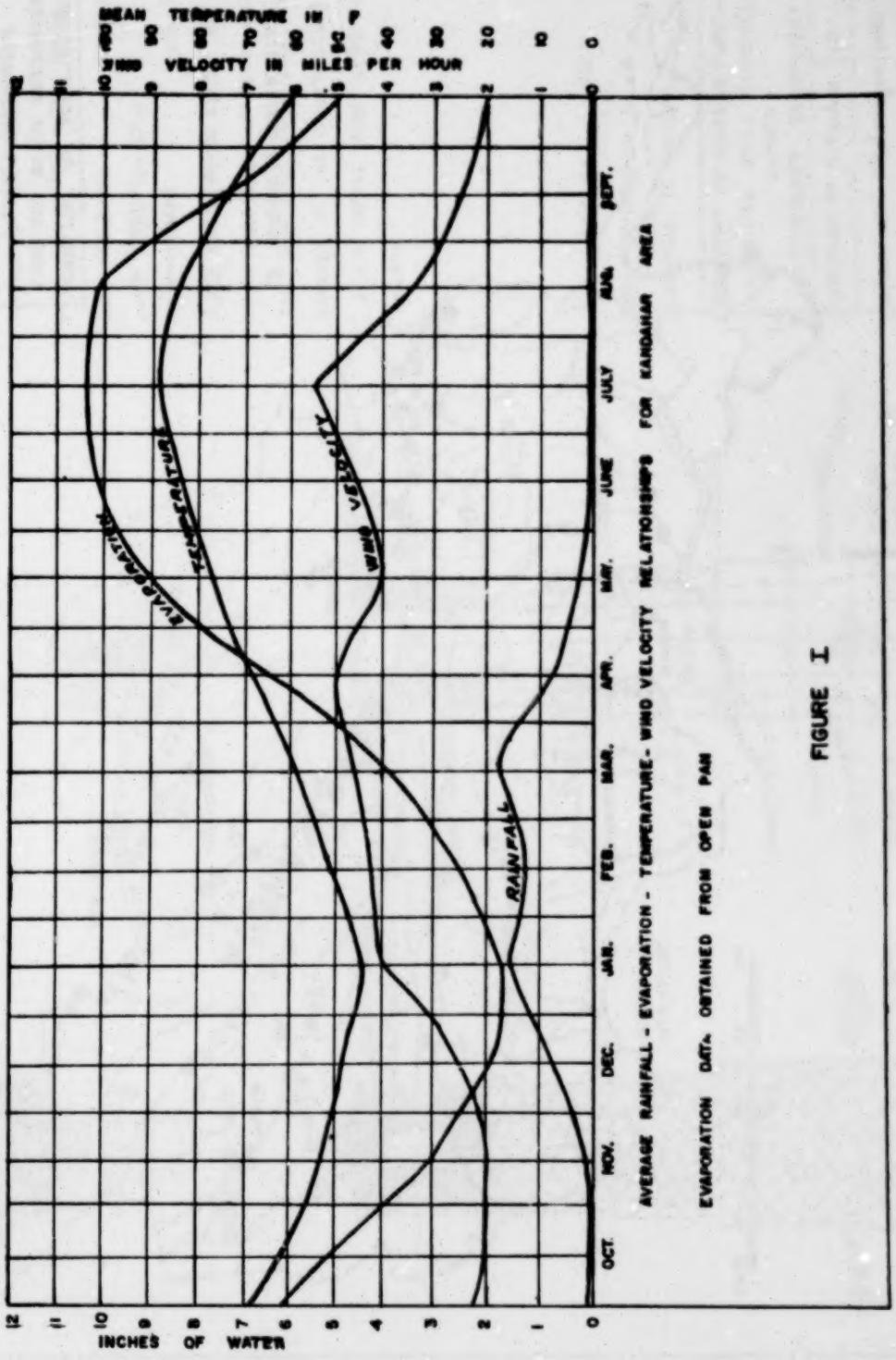

MEAN TEMPERATURE IN F
WIND VELOCITY IN MILES PER HOUR
EVAPORATION
TEMPERATURE
WIND VELOCITY
RAINFALL
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEPT.
INCHES OF WATER
AVERAGE RAINFALL - EVAPORATION - TEMPERATURE - WIND VELOCITY RELATIONSHIPS FOR KANDAHAR AREA
EVAPORATION DATA OBTAINED FROM OPEN PAN

FIGURE I

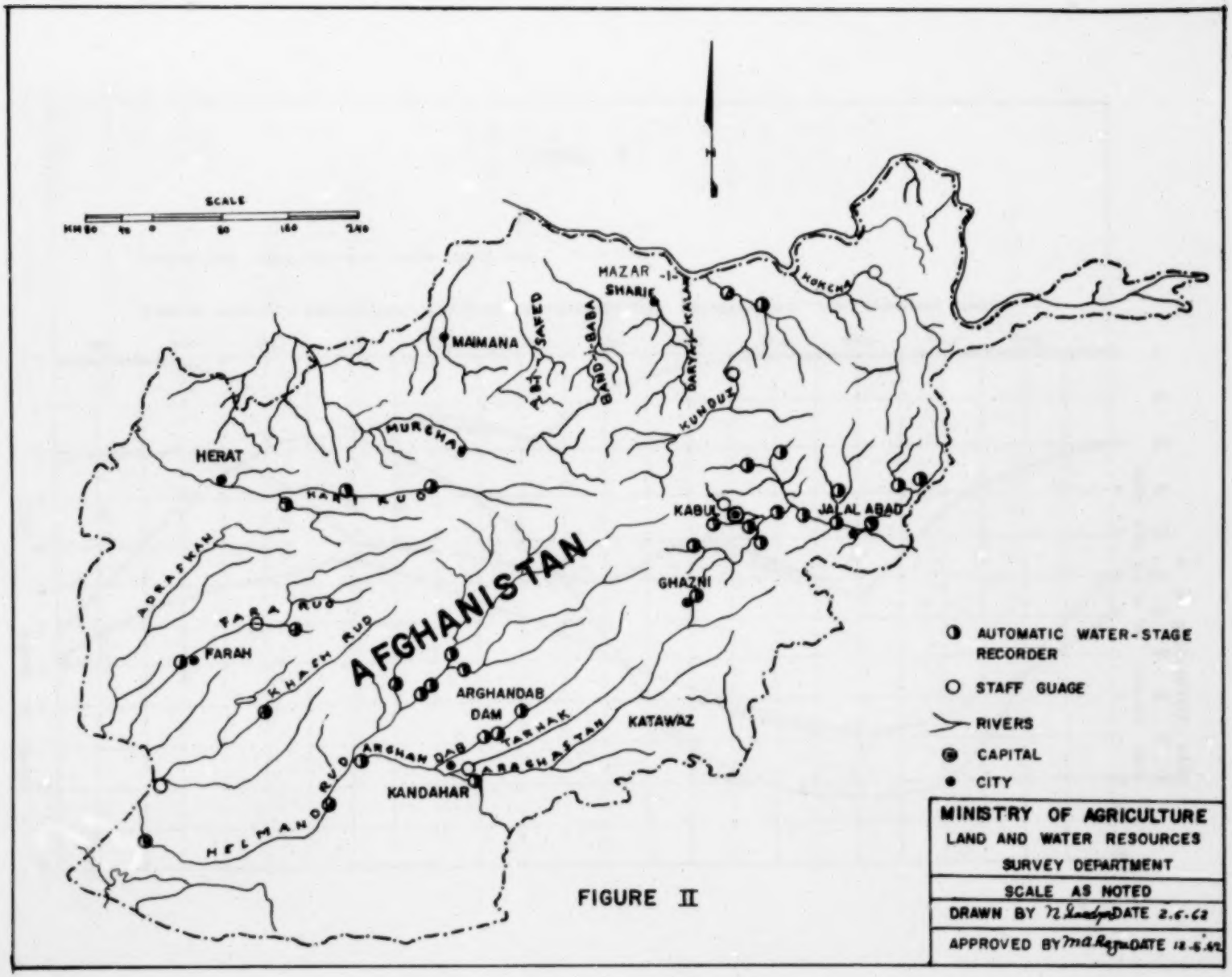
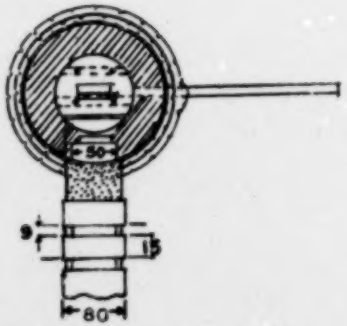
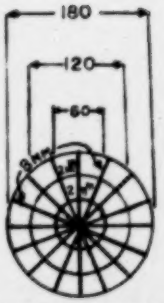

SCALE
KM 50 25 0 50 100 200
N
MAZAR -I- SHARIF
MAIMANA
TEL SAFED
BAND-I-BABA
DARYA-I-KALAN
KUNDUZ
HORCHA
HERAT
MURGHAB
HARI RUD
KABUL
JALALABAD
GHAZNI
AFGHANISTAN
ADRASKAN
FARA RUD
FARAH
KHASH RUD
ARGHANDAB DAM
TARNAK
KATAWAZ
ARGHANDAB
ARASHASTAN
KANDAHAR
HELMAND RV
AUTOMATIC WATER-STAGE RECORDER
STAFF GUAGE
RIVERS
CAPITAL
CITY
MINISTRY OF AGRICULTURE
LAND AND WATER RESOURCES
SURVEY DEPARTMENT
SCALE AS NOTED
DRAWN BY M. Saadyn DATE 2.6.62
APPROVED BY M.A. Raza DATE 12.6.62

FIGURE II



SECTION B-B



ROOF REINFORCEMENT DETAIL

NOTE :-

CEMENT SAND MIX FOR FOUNDATION AND WALLS 1:3

CONCRETE MIX FOR ROOF, BRIDGE 1:2:4

B.M. ELEVATION 2256.848

ZERO MARK OF STAFF GAGE 2251.712

PLAIN REINFORCING STEEL USED.

GRANITE AND SANDSTONE FOR THE STRUTURE FROM AVIALABLE SOURCES AT THE CONSTRUCTION SITE.

4 in Φ METAL PIPE USED FOR INLET.

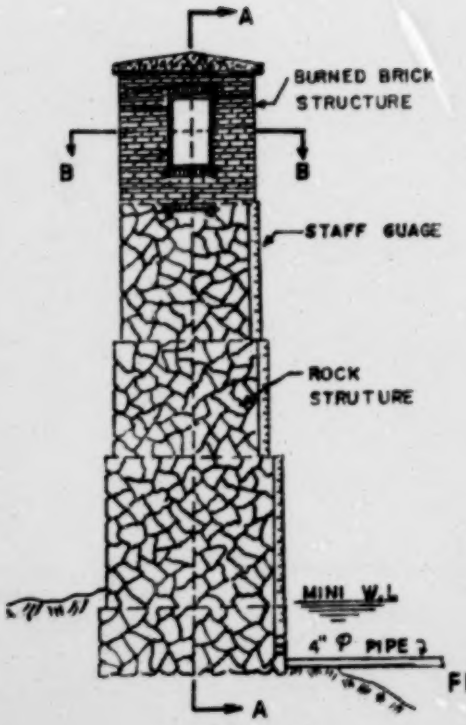
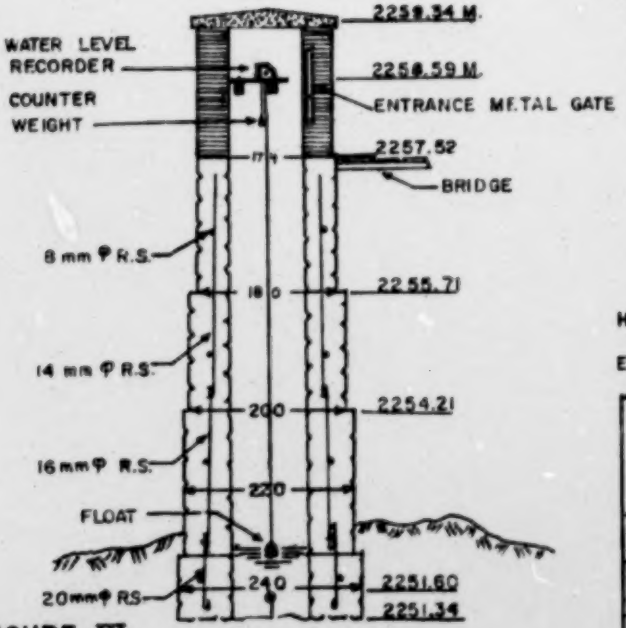


FIGURE III



SECTION A-A

SCALE : 1:80

HORIZ. DIMENSION IN CM.

ELEVATION IN METERS

MINISTRY OF AGRICULTURE-UNSF LAND AND WATER RESOURCES SURVEY HYDROLOGY DEPARTMENT	
DESIGNED BY A. Rashid	NO.
DRAWN BY M. Soodgar	DATE
APPROVED BY M.Q. Raza	DATE 28 OCT 68

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